SHORE LINE ON THE ISLAND OF ST. CROIX

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THE FUNGOUS FLORA OF ST. CROIX

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(WITH PLATE 1)

Immediately following the week on St. Thomas, a report of which has been published,[1] we sailed for St. Croix spending one week also on this island, which is the largest of the three main bodies of land collectively known as the American Virgin Islands.

St. Croix is about twice the size of its neighbor St. Thomas. Unlike the latter the island is fertile and quite suitable for agriculture, although at times and in parts it is too dry for the most satisfactory results. Large quantities of cane are grown here and, in fact, one of the best varieties known is a product of St. Croix.

The surface is less hilly and automobile roads enable one to reach any part of the island without difficulty. The conditions which favor agriculture would also be favorable for mycological work, although the total number of fungi collected during the week only slightly exceeded the number taken in St. Thomas in the same length of time. On the whole, however, conditions may be said to be more conducive to mycological work than in St. Thomas.

During our sojourn in St. Croix, we made our base at Christiansted using as living quarters the old government house which was turned over to us by the courtesy of Governor Hough. The time between trips to other parts of the island was spent in the hills in the vicinity of Christiansted. One of the best collecting grounds from a mycological point of view was the valley of the

[1] MYCOLOGIA **16**: 1–15. 1924.

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Crequis river in the western part of the island, although little time was spent there.

On March 23, we covered Eagle Mountain, the highest elevation in the island, ascending one slope and descending more abruptly on the opposite side. This also proved to be a fruitful excursion. The view from this elevation was very inspiring, commanding as it did the greater part of the island.

On March 25, just before sailing for Porto Rico, a short tramp was made into the suburbs of Christiansted and resulted in the finding of the spongy polypore, *Tomophagus Colossus*, a very rare fungus as noted in the following list. As in the St. Thomas list, the species below in full face type are those collected for the first time while the starred (*) species are those previously collected and recollected by us.

In addition to the literature cited in the "Fungous Flora of St. Thomas," Millspaugh's Flora of St. Croix[2] contains a number of additional species of fungi.

CHYTRIDIALES

Synchytrium decipiens Farlow, Bot. Gaz. **10:** 240. 1885.

On *Dolicholus* sp. collected on Mt. Eagle.

The fungus appears on both leaves and stems forming conspicuous gall-like growths on the latter.

MUCORALES

Pilobolus crystallinus (Wigg.) Tode, Fungi Meckl. **1:** 41. 1790.

Hydrogera crystallina Wigg. Fl. Holsat. 110. 1780.

Collected on dung.

PERONOSPORALES

Albugo Bliti (Biv.) Kunze, Rev. Gen. Pl. **2:** 658. 1891.

Uredo Bliti Biv. Stirp. Rar. Silicia **3:** 658. 1891.

On *Amaranthus tristis* L.

ALBUGO IPOMOEAE-PANDURANAE (Schw.) Swing. Jour. Myc. **7:** 112. 1892.

[2] Field Mus. Nat. Hist. Publ. Bot. **1:** 465–467. 1902.

Accidium Ipomoeae-panduranae Schw. Schr. Nat. Ges. Leipzig **1:** 69. 1822.

Reported by Ferdinandsen & Winge on *Ipomoea Pes-caprae* L. *Albugo Tragopogonis* (DC.) S. F. Gray is reported by Millspaugh on the same host and is probably identical with the above.

Peronoplasmopara cubensis (Berk. & Curt.) Clint. Rep. Conn. Agr. Exp. Station **1904:** 335. 1905.

Peronospora cubensis Berk. & Curt. Jour. Linn. Soc. **10:** 363. 1868.

Collected on *Cucumis Anguria* L.

PERISPORIALES

ASTERINA COCCOLOBAE Ferd. & Winge, Bot. Tidssk. **29:** 10. 1908.

Described from material collected in St. Croix by Raunkiaer on *Coccolobis Uvifera* (L.) Jacq.

ASTERINA COLUBRINAE Ellis & Kels. Bull. Torrey Club **24:** 207. 1897.

Reported on *Colubrina reclinata* (L'Hér.) Brongn. by Millspaugh.

ERYSIPHE COMMUNIS (Wallr.) Fries, Summa Veg. Scand. 406. 1849.

Alphitomorpha communis Wallr. Fl. Crypt. Germ. **2:** 758. 1833.

Reported by Ferdinandsen & Winge on *Sida* sp. So far as we are aware, the perfect stage of this species has not been found in the West Indies so that the identity of the species is somewhat in doubt.

Parodiella grammodes (Kunze) Cooke, Grevillea **13:** 106. 1884.

Sphaeria grammodes Kunze, Berk. Jour. Linn. Soc. **10:** 390. 1868.

Collected on *Crotalaria retusa* L.

PHACIDIALES

Tryblidium rufulum (Spreng.) Ellis & Ev. N. Am. Pyrenom. 690. 1892.

Hysterium rufulum Spreng. Vet. Akad. Handl. **1820:** 50. 1820.
Collected commonly on dead sticks.

PEZIZALES

LACHNEA SCUTELLATA (L.) Gill. Champ. Fr. Discom. 75. 1879.
Peziza scutellata L. Sp. Pl. 1181. 1753.
Reported by Ferdinandsen & Winge.

Patellaria atrata (Hedw.) Fries, Syst. Orbis Veg. 114. 1825.
Lichen atratus Hedw. Laub-Moose **2:** 73. 1788.
Collected on coconut petioles.

Pyronema omphalodes (Bull.) Fuckel, Symb. Myc. 319. 1869.
Peziza omphalodes Bull. Herb. Fr. *pl. 485. f. 1.* 1790–Hist. Champ. 264. 1791.
Collected on burnt ground.

HYSTERIALES

Glonium clavisporum sp. nov.

Apothecia gregarious, rather prominent, parallel, straight or slightly curved, the lips tightly closed, black, striately marked, reaching a length of two or three mm.; asci clavate, 8-spored, in mass yellowish or yellowish-green, reaching a length of 100–120 μ and a diameter of 10–12 μ; spores 1-seriate with the ends strongly overlapping, clavate-fusoid, 1-septate, constricted at the septum, hyaline, reaching a length of 20 μ (or rarely 22 μ) and a diameter of 6–7 μ.

On decorticated wood.

This species was first collected in Nicaragua by C. L. Smith and labeled, apparently by Mr. Ellis, *Glonium simulans* Ger. f. *macrospora*. So far as the writer can discover, this name has never been published. The name proposed by Ellis is untenable as a specific name since it has been applied to a very different species from Mississippi by Tracy and Earle. A sterile specimen of what appears to be the same plant was collected in Porto Rico by Underwood and Griggs. Our specimen for which the above name had already been suggested agrees well with specimens collected in Nicaragua for which Mr. Ellis suggested the name "macrospora." Since that name is untenable we publish our own.

HYPOCREALES

CREONECTRIA OCHROLEUCA (Schw.) Seaver, Mycologia **1:** 190. 1909.

Sphaeria ochroleuca Schw. Trans. Am. Phil. Soc. II. **4:** 204. 1832.

Reported by Ferdinandsen & Winge under the name of *Nectria vulgaris* Speg., which is regarded as a synonym of the above.

HYPOCREA RUFA (Pers.) Fries, Summa Veg. Scand. 383. 1849.

Sphaeria rufa Pers. Obs. Myc. **1:** 20. 1796.

Reported by Børgesen & Paulsen.

LISEA AUSTRALIS Speg. Anal. Soc. Ci. Argent. **12:** —76. 1881.

Reported by Børgesen & Paulsen.

Nectria episphaeria (Tode) Fries, Summa Veg. Scand. 388. 1849.

Sphaeria episphaeria Tode, Fungi Meckl. **2:** 21. 1791.

Collected on the remains of old sphaeriaceous fungi.

FIMETARIALES

Fimetaria fimicola (Roberge) Griffiths & Seaver, N. Am. Fl. **3:** 66. 1910.

Sphaeria fimicola Roberge; Desmaz. Ann. Sci. Nat. III. **11:** 353. 1849.

Collected on dung.

PHYLLACHORALES

Phyllachora biareolata Speg. An. Soc. Ci. Arg. **26:** 36. 1888.

On *Eugenia rhombea* (Berg.) Krug & Urban.

This was at first referred to *Phyllachora Whetzelii* Chardon but on comparison with authentic material was found to differ from that species in the much larger stromata as well as in spore sizes. It seems to agree with the above named species from South America so far as we can judge, although no authentic material has been seen.

Phyllachora Crotonis (Cooke) Sacc. Syll. Fung. **2:** 599. 1883.

Dothidea Crotonis Cooke, Grevillea **10:** 129. 1882.

Collected on the leaves of *Croton* sp.

PHYLLACHORA GRAMINIS (Pers.) Fuckel, Symb. Myc. 216. 1869.
Sphaeria graminis Pers. Obs. Myc. **1:** 18. 1796.
Reported by Millspaugh from St. Croix.

Phyllachora sphaerosperma Winter, Hedwigia **23:** 170. 1884.
Collected on *Cenchrus* ? (host without fruit).

Phyllachora Rickseckeri Ellis & Kels. (in herb.) sp. nov.

Stromata 150–170 μ, pierced above; asci clavate, 40–50 x 12–15 μ, short-stipitate, 8-spored, aparaphysate; sporidia crowded, fusoid, deep reddish-brown in the mass, pale brownish when seen singly, 4–5-nucleate, 20–26 x 4–5 μ.

On *Cissampelos Pareira* L. Signal Hill, St. Croix, Feb. 10, 1896.

While the spores are described as colored they appear practically hyaline or at most faintly yellowish. Listed by Millspaugh as *Guignardia* sp.

SPHAERIALES

Daldinia concentrica (Bolt.) Ces. & DeNot. Comm. Critt. Ital. **1:** 198. 1863.
Sphaeria concentrica Bolton, Fungi Halifax **3:** 180. 1789.
Collected on old wood.

DALDINIA ESCHSCHOLZII (Ehrenb.) Rehm, Ann. Myc. **2:** 175. 1905.
Sphaeria Eschscholzii Ehrenb. Horae Physicae 89. 1820.
Reported by Ferdinandsen & Winge. A large plant, possibly only a form of the preceding.

GUIGNARDIA PIPERICOLA Stevens, Trans. Ill. Acad. Sci. **10:** 183. 1917.

Collected on *Piper Amalago* L. Probably *Physalospora* sp. reported by Millspaugh on *Piper Sieberi* DC. is the same as the above, although no specimen is available for confirmation of this suspicion.

* HYPOSPILA CORDIANA Ellis & Kels. Bull. Torrey Club **24:** 208. 1897.
Trabuticlla Cordiae Stevens, Bot. Gaz. **70:** 401. 1920.

Collected on *Cordia callococca* L. Comparison with authentic material shows the above species described by Stevens to be identical with that of Ellis and Kelsey. Stevens (l.c.) established the genus *Trabutiella* for this species. The name is untenable, having been previously used by Theissen & Sydow for an entirely different plant (Ann. Myc. **13:** 359).

Hypoxylon annulatum (Schw.) Mont. in Hist. Chil. **7:** 445. 1854.

Sphaeria annulata Schw. Jour. Acad. Sci. Phila. **5:** 16. 1825.

Collected commonly on old wood.

Hypoxylon effusum Nits. Pyrenom. Ger. 48. 1867.

Specimens collected on old wood appear to conform well with the description of the above species.

Hypoxylon fusco-purpureum (Schw.) Berk. Jour. Linn. Soc. **10:** 385. 1869.

Sphaeria fusco-purpurea Schw. Jour. Acad. Sci. Phila. **5:** 16. 1825.

Collected on old wood.

Hypoxylon fuscum (Pers.) Fries, Summa Veg. Scand. 384. 1849.

Sphaeria fusca Pers. Syn. Fung. 12. 1801.

Collected on the bark of tree.

Hypoxylon jecorinum Berk. & Rav.; Berk. Grevillea **4:** 50. 1875.

Collected on old wood.

HYPOXYLON PSEUDOPACHYLOMA Speg. Bol. Acad. Ci. Cordoba **11:** 206. 1887.

Reported by Ferdinandsen & Winge for St. Croix.

HYPOXYLON RUBIGINOSUM (Pers.) Fries, Summa Veg. Scand. 384. 1849.

Sphaeria rubiginosa Pers. Syn. Fung. 11. 1801.

Reported from St. Croix by Ferdinandsen & Winge.

NUMMULARIA DURA Ferd. & Winge, Bot. Tidssk. **29:** 15. 1908.

Reported by Ferdinandsen & Winge on dead branches.

NUMMULARIA REPANDA (Fries) Nitsch. Pyrenom. Ger. 57. 1867.
Sphaeria repanda Fries, Obs. Myc. **1:** 168. 1815.
Collected commonly on dead branches.

Nummularia tinctor (Berk.) Ellis & Ev. N. Am. Pyrenom. 627. 1892.
Sphaeria tinctor Berk. in Hooker, Jour. Bot. **4:** 311. 1845.
Collected on old wood.

Physalospora Andirae Stevens, Trans. Ill. Acad. Sci. **10:** 184. 1917.
Collected on leaves of *Andira inermis* H.B.K. [*Andira jamaicensis* (W. Wr.) Urb.].

Poronia Oedipus Mont. Syll. Fung. 209. 1856.
Collected commonly on manure.

Rosellinia aquila (Fries) DeNot. Atti. Sci. Ital. **6:** 485. 1845.
Sphaeria aquila Fries, Syst. Myc. **2:** 442. 1822.
Collected on old wood.

Rosellinia Bresadolae Theiss. Ann. Myc. **6:** 351. 1908.
Collected on old wood.

ROSELLINIA METACHROA Ferd. & Winge, Bot. Tidssk. **29:** 16. 1908.
Reported by Ferdinandsen & Winge on old wood.

ROSELLINIA ST. CRUCIANA Ferd. & Winge, Bot. Tidssk. **29:** 16. 1908.
Described from material collected in St. Croix on petioles of *Cocos nucifera* L.

Rosellinia subiculata (Schw.) Sacc. Syll. Fung. **1:** 255. 1882.
Sphaeria subiculata Schw. Schr. Nat. Ges. Leipzig **1:** 44. 1822.
Collected on old wood.

SPIROGRAMMA BOERGESENII Ferd. & Winge, Vidensk. Meddel **1908:** 143.
The genus and species are based on material collected in St. Croix and St. Jan.

Valsa chlorina Pat. Bull. Soc. Myc. Fr. **22:** 56. 1906.
?Eutypella Cocos Ferd. & Winge, Vidensk. Meddel **1908:** 141. 1908.
On old coconut husks.

XYLARIA APPENDICULATA Ferd. & Winge, Bot. Tidssk. **29:** 17. 1908.
Reported by Ferdinandsen & Winge on dried leaves of *Crescentia cucurbitina* L.

Xylaria apiculata Cooke, Grevillea **8:** 66. 1879.
Collected on old wood.

XYLARIA LIGNOSA Ferd. & Winge, Bot. Tidssk. **29:** 18. 1908.
Described from material collected in St. Croix.

PHYLLOSTICTALES

CICINNOBOLUS sp.
Reported by Ferdinandsen & Winge on *Crotalaria retusa* L. and *Priva lappulacea* (L.) Pers.

DARLUCA FILUM (Biv.) Sacc. Syll. Fung. **3:** 410. 1884.
Sphaeria Filum Biv.-Bern. Stirp. Rar. Manip. **3:** 12. 1815.
Reported by Ferdinandsen & Winge on *Puccinia Synedrellae* P. Henn.

Phoma lathyrina Sacc. Michelia **2:** 274. 1881.
Collected on pods of *Albizzia Lebbeck* (L.) Benth.

Phyllosticta Pithecolobii Young, Mycologia **7:** 145. 1915.
Collected on *Pithecolobium Unguis-cati* (L.) Benth.

HYPHOMYCETES

CHROMOSPORIUM PACHYDERMA Ferd. & Winge, Bot. Tidssk. **29:** 22. 1908.
Described from material collected in St. Croix, on rotten wood.

FUMAGO VAGANS Pers. Myc. Eu. **1:** 9. 1822.
Reported by Ferdinandsen & Winge on *Wedelia buphthalmoides* Griseb.; also collected on the leaves of some undetermined host.

OIDIUM CYPARISSIAE Syd. Hedwigia **36:** (163). 1897.

Reported by Ferdinandsen & Winge on *Euphorbia pilulifera* L.; also an unnamed species of *Oidium* has been reported on various hosts.

Oidium erysiphoides Fries, Syst. Myc. **3:** 432. 1829.

Collected on living leaves of cultivated peppers.

PERICONIA ATRA Corda, Ic. Fung. **1:** 19. 1837.

Reported by Ferdinandsen & Winge on *Saccharum officinarum* L.

TRICHODERMA LIGNORUM (Tode) Harz. Bull. Soc. Imp. Mosc. **44:** 116. 1871.

Pyrenium lignorum Tode, Fungi Meckl. **1:** 33. 1790.

Reported by Ferdinandsen & Winge.

UREDINALES

COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm. Myc. Univ. 953. 1878.

Uredo Elephantopodis Schw. Schr. Nat. Ges. Leipzig **1:** 70. 1822.

Reported by Ferdinandsen & Winge on *Elephantopus mollis* Kth. under the name of *Coleosporium Sonchi* Schw.

COLEOSPORIUM IPOMOEAE (Schw.) Bur. Bull. Ill. Lab. Nat. Hist. **2:** 217. 1885.

Uredo Ipomoeae Schw. Schr. Nat. Ges. Leipzig **1:** 70. 1822.

Reported by Millspaugh on *Ipomoea coccinea* L.; also collected by Dr. J. N. Rose on *Ipomoea Nil* (L.) Roth.

ENDOPHYLLUM CIRCUMSCRIPTUM (Schw.) Whetzel & Olive, Am. Jour. Bot. **4:** 49. 1917.

Aecidium circumscriptum Schw.; Berk. & Curt. Jour. Phila. Acad. Sci. **2:** 283. 1853.

Aecidium Cissi Winter, Hedwigia **23:** 168. 1884.

Reported on *Cissus sicyoides* L.

* PROSPODIUM APPENDICULATUM (Wint.) Arth. Jour. Myc. **13:** 31. 1907.

Puccinia appendiculata Winter, Flora **67:** 262. 1884.

Collected on *Tecoma Stans* (L.) Juss.

PUCCINIA ARECHAVALETAE Speg. Anal. Soc. Ci. Argent. **12:** 67. 1881.

Reported by Ferdinandsen & Winge on *Cardiospermum microcarpum* H.B.K.

Puccinia Blechi Lagerh. Bull. Soc. Myc. Fr. **11:** 214. 1895.

Collected on *Blechum Blechum* (L.) Millsp.

PUCCINIA CENCHRI Dietl. & Holw.; Holway, Bot. Gaz. **24:** 28. 1897.

Collected on *Cenchrus* sp.

PUCCINIA CRASSIPES Berk. & Curt.; Berk. Grevillea **3:** 54. 1874.

Reported by Ferdinandsen & Winge on *Ipomoea triloba* L. and *Quamoclit coccinea* (L.) Moench. under the name of *Puccinia Ipomoeae-panduranae*. Also reported by Millspaugh under the name of *Puccinia opulenta* Speg.

* PUCCINIA EMILIAE P. Henn. Hedwigia **37:** 278. 1898.

Reported by Ferdinandsen & Winge on *Emilia sagittifolia* [*sagittata* DC.] and *Emilia sonchifolia* (L.) DC. Also collected on *Emilia* sp.

PUCCINIA HETEROSPORA Berk. & Curt. Jour. Linn. Soc. **10:** 356. 1868.

Uromyces Sidae Thüm. Rev. Myc. **1:** 10. 1879.

Reported on *Abutilon periplocifolium* Sw.; *Metastelma Schlechtendalii* Dec.; and *Sida supina glabra*.

Puccinia Huberi P. Henn. Hedwigia Beibl. **39:** 76. 1900.

Collected on *Panicum adspersum* Trin.

* PUCCINIA IMPEDITA Mains & Holw.; Arth. Mycologia **10:** 135. 1918.

Collected on *Salvia occidentalis* Sw. Also reported by Ferdinandsen & Winge under the name of *Puccinia Menthae* Pers.

PUCCINIA INFLATA Arth. Bull. Torrey Club **33:** 516. 1906.

Reported by Ferdinandsen & Winge on *Stigmatophyllum periplocifolium* A. Juss. under the name of *Puccinia insueta* Wint.

PUCCINIA INSULANA (Arth.) Jackson, Bot. Gaz. **65:** 296. 1918.
Argomyces insulanus Arth. Mycologia **7:** 179. 1915.
Reported on *Vernonia* sp. under the name of *Puccinia Vernoniae* Cooke. Also collected on *Vernonia albicaulis* Pers.

PUCCINIA INVAGINATA Mains & Holw.; Arth. Mycologia **10:** 135. 1918.
Uredo Gouaniae Ellis & Kelsey, Bull. Torrey Club **24:** 209. 1897.
Collected on *Gouania polygama* (Jacq.) Urban.

Puccinia Leonotidis (P. Henn.) Arth. Mycologia **7:** 245. 1915.
Uredo Leonotidis P. Henn. in Engler, Pfl. Ost.-Afr. **C:** 52. 1895.
Collected on *Leonotis nepetaefolia* (L.) R. Br.

Puccinia levis (Sacc. & Bizz.) Magnus, Ber. Deuts. Bot. Ges. **9:** 190. 1891.
Diorchidium leve Sacc. & Bizz.; Sacc. Michelia **2:** 648. 1882.
Collected on *Paspalum fimbriatum* H.B.K.

PUCCINIA MACROPODA Speg. Anal. Soc. Ci. Argent. **10:** 13. 1880.
Reported by Ferdinandsen & Winge on *Iresine elatior* L.

PUCCINIA OBLIQUA Berk. & Curt.; Berk. Jour. Linn. Soc. **10:** 356. 1858.
Collected on *Metastelma Schlechtendalii* Dec. by Dr. J. N. Rose. Also collected by A. E. Ricksecker.

PUCCINIA SPERMACOCES Berk. & Curt. Grevillea **3:** 53. 1874.
Reported by Millspaugh on *Spermacoce* sp.; *Borreria parviflora* G. F. W. Meyer.

* PUCCINIA SYNEDRELLAE P. Henn. Hedwigia **37:** 277. 1898.
On *Synedrella nodiflora* (L.) Gaertn.

Puccinia Urbaniana P. Henn. Hedwigia **37:** 278. 1898.
Collected on *Valerianodes.*

PUCCINIOSIRA PALLIDULA (Speg.) Lagerh. Tromsö Mus. Aarsh. **16:** 122. 1894.
Aecidiella Triumfettae Ellis & Kelsey, Bull. Torrey Club **24:** 208. 1897.

Reported by Ferdinandsen & Winge on *Triumfetta* sp.

Uredo Erythroxylonis Graz. Bull. Soc. Myc. Fr. **7:** 153. 1891.
Collected on *Erythroxylon* sp.

* UREDO JATROPHICOLA Arth. Mycologia **7:** 331. 1915.
Collected on *Jatropha gossypifolia* L. Also collected by Dr. J. N. Rose.

Uromyces Anthacanthi H. S. Jackson, Mycologia **16:** 47. 1923.
Collected on *Anthacanthus spinosus* (Jacq.) Nees.
The species was described from material collected in St. Croix.

* UROMYCES COMMELINAE Cooke, Trans. Roy. Soc. Edinb. **31:** 342. 1888.
Uredo Commelinaceae Ellis & Kelsey, Bull. Torrey Bot. Club **24:** 209. 1897.
On *Commelina elegans* H.B.K.

Uromyces Dolicholi Arth. Bull. Torrey Club **33:** 27. 1906.
On *Dolicholus* sp.; *Cajan Cajan* (L.) Millsp.

UROMYCES EUPHORBIAE Cooke & Peck; Peck, Ann. Rep. N. Y. State Mus. **25:** 90. 1873.
Reported by Ferdinandsen & Winge on *Euphorbia prostrata* Ait.

UROMYCES GEMMATUS Berk. & Curt.; Berk. Jour. Linn. Soc. **10:** 357. 1869.
Reported by Millspaugh on *Convolvulus nodiflorus* Desr. under the name of *Puccinia Convolvuli* (Pers.) Cast.

Uromyces leptodermus Syd.; Syd. & Butler, Ann. Myc. **4:** 430. 1906.
Collected on *Panicum barbinode* Trin.

USTILAGINALES

USTILAGO ZEAE (Beckm.) Unger, Einfl. Bodens 211. 1836.
Lycoperdon Zeae Beckm. Hannov. Mag. **6:** 1330. 1768.
Reported by Ferdinandsen & Winge on *Zea Mays* L.

MYKOSYRINX CISSI (DC.) G. Beck, Ann. Nat. Hofmus. Wien **9:** 123. 1894.

Uredo Cissi DC. in Poir. Encycl. Meth. Bot. **8:** 228. 1808.

Reported by Børgesen & Paulsen on *Cissus* sp.

AGARICALES

Amauroderma flaviporum Murrill, N. Am. Fl. **9:** 116. 1908.

Collected on old wood.

Campanularius solidipes (Peck) Murrill, Mycologia **10:** 31. 1918.

Agaricus solidipes Peck, Ann. Rep. N. Y. State Cab. **23:** 101. 1872.

Collected on dung.

CORIOLUS NIGROMARGINATUS (Schw.) Murrill, Bull. Torrey Club **32:** 649. 1906.

Boletus nigromarginatus Schw. Schr. Nat. Ges. Leipzig **1:** 98. 1822.

Reported by Børgesen & Paulsen under the name of *Polyporus hirsutus* Fries which is regarded by Murrill as a synonym of the above.

Coriolopsis fulvocinerea Murrill, N. Am. Fl. **9:** 76. 1908.

Collected on dead wood.

Coriolopsis occidentalis (Klotzsch) Murrill, Bull. Torrey Club **32:** 358. 1905.

Polyporus occidentalis Klotzsch, Linnaea **8:** 486. 1833.

Collected on old wood.

Coriolopsis rigida (Berk. & Mont.) Murrill, N. Am. Fl. **9:** 75. 1908.

Trametes rigida Berk. & Mont. Ann. Sci. Nat. III. **11:** 240. 1849.

Collected on dead wood.

Coriolus pinsitus (Fries) Pat. Tax. Hymén. 94. 1900.

Polyporus pinsitus Fries, Elench. Fung. 95. 1828.

Collected on old wood.

COPRINUS PLICATILIS Fries, Epicr. Myc. 252. 1836.
Reported from St. Croix by Fries.

* DAEDALEA AMANITOIDES Beav. Fl. Oware **1:** 44. 1805.
Collected on old wood. Also reported by Børgesen & Paulsen under the name of *Trametes elegans* (Spr.) Fries, which is now regarded as a synonym of the above.

* ELFVINGIELLA FASCIATA (Sw.) Murrill, Trop. Poly. 90. 1915.
Boletus fasciatus Sw. Prodr. 149. 1788.
Collected on old wood. Also reported by Børgesen & Paulsen under the name of *Polyporus fomentarius* (L.) Fries.

FLAMMULA PEREGRINA (Fries) Sacc. Syll. Fung. **5:** 814. 1887.
Agaricus peregrinus Fries, Elench, Fung. **1:** 31. 1827.
Reported from St. Croix by Fries on wood.

Ganoderma subincrustatum Murrill, N. Am. Fl. **9:** 122. 1908.
Collected on old wood.

Gloeophyllum striatum (Sw.) Murrill, Bull. Torrey Club **32:** 370. 1905.
Agaricus striatus Sw. Prodr. 148. 1788.
Collected on old wood.

Hapalopilus lichnoides (Mont.) Murrill, Bull. Torrey Club **31:** 417. 1904.
Polyporus lichnoides Mont. Pl. Cell. Cuba 401. 1842.
Collected on old wood.

HIATULA DISCRETA (Fries) Sacc. Syll. Fung. **5:** 307. 1887.
Agaricus discretus Fries, Elench. Fung. **1:** 20. 1827.
Reported from St. Croix by Fries.

Lentinus hirtus (Fries) Murrill, Mycologia **3:** 29. 1911.
Agaricus hirtus Fries, Linnaea **5:** 508. 1830.
Collected on old wood.

MARASMIUS ARECARIUS Fries, Epicr. Myc. 380. 1836.
Reported from St. Croix by Fries.

NAUCORIA PEDIADES (Fries) Sacc. Syll. Fung. **5:** 844. 1887.
Agaricus pediades Fries, Syst. Myc. **1:** 290. 1821.
Reported from St. Croix by Fries.

PANUS XYLOPODIUS (Lév.) Fries, Nov. Acta. Soc. Sci. Upsal. III. **1:** 40. 1855.
Lentinus xylopodius Lév. Ann. Sci. Nat. III. **5:** 119. 1846.
Reported from St. Croix by Fries.

Pogonomyces hydnoides (Sw.) Murrill, Bull. Torrey Club **31:** 609. 1904.
Boletus hydnoides Sw. Prodr. 149. 1788.
Collected on old wood.

? **Poria Alabamae** (Berk. & Cooke) Cooke, Grevillea **14:** 113. 1886.
Polyporus Alabamae Berk. & Cooke, Grevillea **6:** 130. 1878.
Collected on old branches.

PSILOCYBE ANTILLARUM (Fries) Sacc. Syll. Fung. **5:** 1052. 1887.
Agaricus Antillarum Fries, Elench. Fung. **1:** 42. 1827.
Reported from St. Croix by Fries.

* PYCNOPORUS SANGUINEUS (L.) Murrill, Bull. Torrey Club **31:** 421. 1904.
Boletus sanguineus L. Sp. Pl. ed. 2. 1646. 1762.
Collected on old wood. Also reported by Millspaugh under the name of *Polystictus sanguineus*.

Schizophyllum alneum (L.) Schroet. Krypt.-Fl. Schles. **3**[1]**:** 553. 1889.
Agaricus alneus L. Sp. Pl. 1176. 1753.
Collected on old sticks.

Stereum papyrinum Mont. Pl. Cell. Cuba 374. 1838. ?
Collected on charred wood.

Tomophagus Colossus (Fries) Murrill, Torreya **5:** 197. 1905.
Polyporus Colossus Fries, Nov. Symb. 56. 1851.
Collected inside an old stump near Christiansted.

Dr. Murrill makes the following note[3] on the species: "Plants collected by Millspaugh No. *57838* in Yucatan appear to be immature specimens of the above species. Oersted's original plants are still preserved at Upsala. Further tropical exploration will doubtless discover more of this remarkable species."

Our plants collected in St. Croix while similar to those taken by Millspaugh are very much lighter in weight and the hymenium much thicker. The distribution of the species according to Murrill (N. Am. Fl. **9:** 30. 1907) is Costa Rica, Yucatan and doubtfully reported from St. Jan. If the determination of our specimens is correct it would tend to confirm the report of the species from the neighboring island of St. Jan. Our specimens are eight or ten inches across, three inches thick and almost as light as cork.

? **Trametes lignea** Murrill, N. Am. Fl. **9:** 44. 1907.
Collected on old wood.

DACRYOMYCETALES

Guepinia Spathularia (Schw.) Fries, Elench. Fung. **2:** 32. 1827.
Merulius Spathularia Schw. Schr. Nat. Ges. Leipzig **1:** 92. 1822.
Collected on charred wood.

LYCOPERDALES

CYATHUS AMBIGUUS Tul. Ann. Sci. Nat. III. **1:** 75. 1844.
Reported by Børgesen & Paulsen.

CYATHUS POEPPEGII Tul. Ann. Sci. Nat. III. **1:** 77. 1844.
Reported by Millspaugh on manure.

CYATHUS VERNICOSUS (Bull.) DC. Fl. Fr. **2:** 270. 1815.
Nidularia vernicosa Bull. Herb. Fr. *pl. 488, f. 1.* 1790.
Reported by Børgesen & Paulsen.

Diplocystis Wrightii Berk. & Curt.; Berk. Jour. Linn. Soc. **10:** 344. 1868.
Collected on sandy ground.

[3] Bull. Torrey Club **32:** 474. 1905.

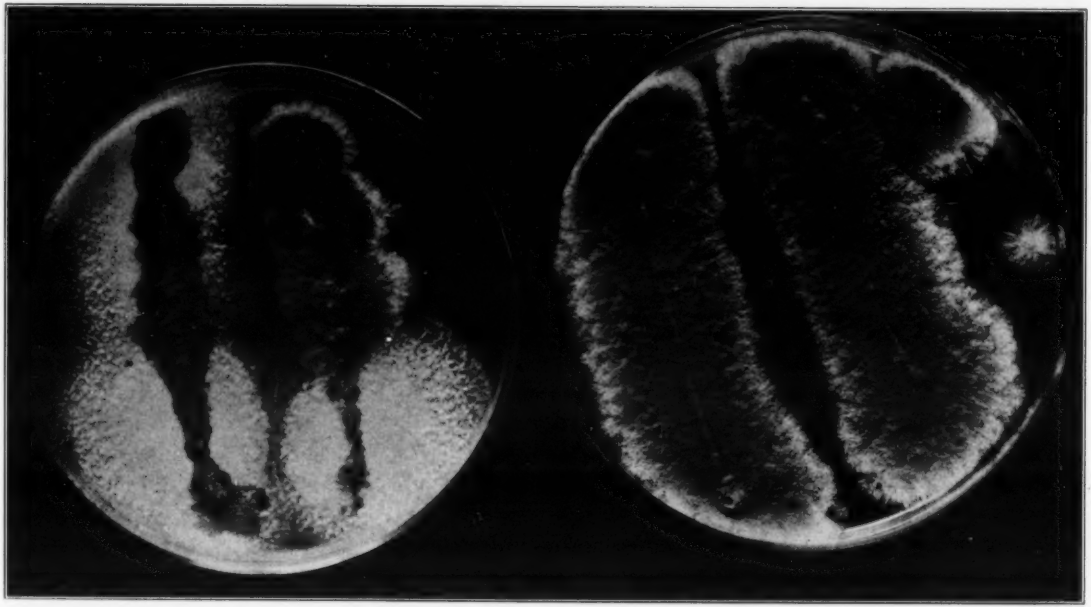
TREMELLALES

Exidia glandulosa (Bull.) Fries, Syst. Myc. **2:** 224. 1822.
Tremella glandulosa Bull. Champ. Fr. *pl. 420, f. 1.* 1788.
Collected on bark.

DOUBTFUL SPECIES

Polyporus resinosus (Schrad.) Fries.

Reported by Børgesen & Paulsen but thought to be due to misdetermination or error.



A photograph of culture 16 (right) and *P. roqueforti* (right) grown on petri dishes on potato agar. The white patches of closely interwoven hyphae are shown on the *P. roqueforti*.

A photograph of culture 16 (right) and *P. roqueforti* (right) grown on petri dishes on potato agar. The white patches of closely interwoven hyphae are shown on the *P. roqueforti*.

THE MOLD ASSOCIATED WITH THE RIPENING OF BLUE VEINED CHEESE

N. S. Golding

(With Plate 2)

Introduction

Three years ago an investigation was commenced in the laboratory of the University of British Columbia, with the object of ascertaining, if possible, a suitable procedure for the making of Wensleydale cheese, on the Pacific Coast of North America (**1**). Some highly satisfactory cheeses have been made, but a rather high percentage of poorer cheeses also resulted. Therefore, it was thought to be desirable to isolate, from several cheeses of good and poor quality respectively, the mold associated with the ripening of these cheeses, and as fully as possible to examine the cultural and morphological characters of the molds recovered. Such striking differences have been found between the pure cultures of the molds isolated from the Wensleydale cheese and from a pure culture of known *Penicillium roqueforti* that the preliminary report may well be published, in spite of the fact that the work is still in progress. It is to be observed that an important phase of the investigation which has not yet been brought to completion is the making of cheese inoculated with the molds dealt with herein.

Considerable work has been done on the organisms associated with the ripening of blue veined cheese, more particularly with the Roquefort and Stilton varieties. From these investigations, the mold *Penicillium roqueforti* (Thom) [*P. glaucum* (Link)] is considered to be, in the case of Roquefort cheese, the only mold that plays an important part in the ripening of this variety (**2**) (**3**) (**4**). Thom (**6**) states, "Although it (*P. roqueforti*) is not restricted in its habitat to cheese, this species is so identified with the ripening process of Roquefort cheese (in which pure cultures are

used) that anyone desiring a culture of this species can always obtain it by purchasing cheese of this type."

The dominance of *P. roqueforti* in the ripening of Roquefort cheese is attributed to (*a*) *P. roqueforti* being able to grow in an atmosphere very low in oxygen (**2**), and (*b*) the high percentage of salt, about 4 per cent in Roquefort, inhibiting the growth of certain other molds (**4**).

In the case of English Stilton cheese the same mold is reported to be the only dominant mold associated with the ripening of the cheese (**3**) (**5**).

With Wensleydale cheese less work has been done. Steuart (**3**) reports that in a Wensleydale cheese he examined, the cheese not being true to type, he found the dominant mold to be a type other than *P. roqueforti*. Steuart does not classify this mold, but in a later part of the same work he reports that when making Wensleydale cheese and inoculating with a pure culture of *P. roqueforti*, excellent cheeses were obtained.

METHODS AND MATERIALS

Method of manufacture.—In the experimental work undertaken for the purpose of ascertaining a suitable procedure for the manufacture of Wensleydale cheese (**1**), it was at once recognized that inoculation was especially necessary, when cheeses of this type were to be made in an entirely new district. Two alternatives were available:

1. Inoculation with a pure culture of *P. roqueforti*.

2. The following of the older practice of inoculating with a small piece of good quality, well ripened Wensleydale cheese obtained from a reliable dairy.

As the factors concerned in the ripening of Wensleydale cheese have not been fully investigated, it was thought safer to follow the older method. During the process of making, the curd was inoculated with a small piece of Wensleydale cheese obtained from the Midland Agricultural and Dairy College, Kingston, Derby, England. By this method it was hoped to introduce all the biological factors associated with the ripening of the cheese. Subsequently, pieces of cheese made in the laboratory of the University of British

Columbia were used for inoculation. One of these constituted the inoculum used for each of the eight cheeses selected for mycological examination. These eight cheeses were judged by Professor Todd of the Dairy department, University College, Reading, England. In this report he states: "I enclose you a criticism of the samples of cheese sent to me which arrived last week. On the whole, I would consider them quite a good lot and you have certainly managed to get hold of the right mold, and though, in some cases, the texture was much too firm and 'cheddary,' I think that with a little experience you ought to be able to produce a first-rate cheese."

Method of isolation.—Samples of all the cheeses judged by Prof. Todd were kept in cold storage and used for mycological examination. In isolating the molds a piece of the outside of the cheese was seared off with a red hot knife. From this cut surface a plug of cheese was taken with a sterile trier, and placed in a petri dish. A small quantity of the blue veined part of the plug was taken and qualitatively plated in three dilutions in duplicate. All the plates were poured with potato agar (**7**) and incubated at 21° C. for three days. In each case, after inoculation, the plates showed a blue-green mold. This mold appeared to be the dominant growth and formed 90 per cent to 100 per cent of all microorganisms present; while in many cases the growth was a pure culture of the mold.

In order to determine whether or not other organisms were present to a greater extent in the complete plug, two plugs from different cheeses were ground up in sterile water—10 c.c. to each plug—and from these suitable dilutions, plates were made. The results showed no appreciable difference from those previously obtained and reported above.

The determinations showed a dominant green mold to be present in all the ripened cheeses. Sub-cultures of this mold were made from the potato-agar plates that were inoculated from the blue veins of the cheese.

No work was done with the other organisms that grew on the plates.

For comparison with the mold isolated from Wensleydale

cheese, a pure culture of *P. roqueforti* was obtained from the Dairy Division, Washington.

Media.—For determining the cultural and morphological characters, the following media were used:

Potato agar + 2 per cent dextrose: as described by Thom (7).

Plain gelatin: 15 per cent gelatin dissolved in distilled water, tubed and sterilized, under 15 lbs. pressure for 20 minutes.

Whey-peptone-litmus-gelatin: Preparation of whey. To 1½ gallons of sweet skim milk at 37° C. rennet was added at the rate of 1 dram rennet per gallon of milk and stirred well. The milk was then left for 30 minutes to clot, after which the curd was broken with a spoon, and the whey expelled by the heating of the whole, on a water bath to 45° C.: 3,000 c.c. of the whey were decanted off and divided into two equal parts. To the one part 450 grams of gelatin were added and heated on a water bath until dissolved. To the second part of the whey 30 grams of peptone were added and heated and stirred till dissolved. The whole was mixed, two eggs were added, the medium heated for 30 minutes under pressure, filtered and brought to an acidity of + 1.0 to phenolphtalein by adding the required quantity of normal NaOH. A sufficient amount of litmus solution previously prepared was added, and the media tubed and sterilized under a pressure of 15 lbs. for 30 minutes.

Plain gelatin and saccharose.—To a 15 per cent gelatin prepared in distilled water, 3 per cent cane sugar was added, and the whole tubed and sterilized under a pressure of 15 lbs. for 20 minutes.

MORPHOLOGICAL CHARACTERS

In the examination of the molds isolated from the various cheeses, the cultural characters of each mold appeared to be identical as far as examined. The following description is therefore applicable to each sub-culture isolated. The Wensleydale mold grows quickly and luxuriantly on potato agar, and on whey gelatin. On gelatin and saccharose gelatin the growth is fair, and on plain gelatin growth is scant. On potato agar the colonies begin to form spores about the second or third days, the spore area varying from grey green to blue grey, turning dirty brown with age.

The margin of the colony is white, strict, and uneven; though the margin can always be described as broad. The underside of the colony is grass green under the spores, and colorless under the margin. The conidiophores arise separately and in acropetal succession from the submerged hyphae, their length being very varied, but seldom greater than 250 μ. The conidial fructification is loose, and has a length up to 100 μ but shows considerable variation. The conidia are oval to round, and have a diameter from 3 μ to 6 μ. The colonies do not liquefy gelatin. In the whey-peptone-litmus-gelatin there is a general tendency to produce acid, though the mold could not be said to be a rapid acid producer.

In comparing the cultural characters of *P. roqueforti* with those of the Wensleydale mold there is a close similarity except as detailed below.

1. In the colonies of *P. roqueforti* there were white patches of closely interwoven hyphae, which in some cases would be more than a centimeter in diameter; these areas never occurred with the Wensleydale mold, fig. *a*.

2. The reverse of the colony of *P. roqueforti* in potato agar was always yellow and not green, as in the case of the Wensleydale mold.

3. The *P. roqueforti* never produced acid in whey gelatin.

PHYSIOLOGICAL CHARACTERS

Digestion of casein.—The data recorded thus far show that the mold from the Wensleydale cheese could not be considered as being identical with *P. roqueforti*. Quantitative determinations were made, therefore, of the degree to which the respective molds digested the casein of skim milk and the casein of acid skim milk respectively. Test tubes containing 15 c.c. sweet skim milk—the milk formed a depth of 1½ in.—were plugged, sterilized, inoculated with the required mold and incubated at room temperature for 11 days—table I.

In preparing the acid skim milk 75 c.c. of skim milk were sterilized in an Erlenmeyer flask, cooled and acidified with 10 c.c. of sterile lactic acid solution having an acidity of + 21.2. Ten c.c. of this milk was then pipetted under sterile conditions into large

test tubes. The tubes, which had a depth of about 1 in. of milk, were then inoculated and incubated at room temperature for 11 days—table I.

TABLE I

THE DIGESTION OF CASEIN IN SKIM MILK AND ACID SKIM MILK CULTURES GROWN AT ROOM TEMPERATURE IN TEST TUBES FOR 11 DAYS

SKIM MILK (15 C.C.)

Cultures	Percentage of casein	Percentage soluble nitrogen expressed as protein	Percentage of casein digested
Uninoculated control	*a.* 2.67	.60	
	b. 2.67	.55	
	c. 2.71	.63	
Average	2.68	.59	
P. roqueforti	*a.* 2.19	1.16	
	b. 2.17	1.05	
Average	2.18	1.10	18.6
Culture 15 (from Wensleydale cheese made May 29th, 1922)	*a.* 2.54	.73	
	b. 2.58	.72	
Average	2.56	.72	4.5

ACID SKIM MILK (10 C.C.)

Cultures	Percentage of casein	Percentage soluble nitrogen expressed as protein	Percentage of casein digested
Uninoculated control	*a.* 2.74	.76	
	b. 2.72	.86	
Average	2.73	.81	
P. roqueforti	*a.* 1.56	1.95	
	b. 1.80	1.64	
Average	1.68	1.79	38.8
Culture 16 (from Wensleydale cheese made Aug. 3, 1922)	*a.* 2.59	1.10	
	b. 2.41	1.10	
Average	2.50	1.10	8.4

TABLE II

THE DIGESTION OF CASEIN IN SKIM MILK AND ACID SKIM MILK CULTURES GROWN AT ROOM TEMPERATURE IN ERLENMEYER FLASKS FOR TEN DAYS

SKIM MILK

Cultures	Percentage of casein	Percentage soluble nitrogen expressed as protein	Percentage of casein digested
Uninoculated control	*a.* 2.79	.57	
	b. 2.79	.58	
Average	2.79	.57	
P. roqueforti	*a.* .70	2.61	
	b. .73	2.61	
	c. .69	2.66	
Average	.71	2.63	74.6
Culture 16 (from Wensleydale cheese made Aug. 3, 1922)	*a.* 2.36	1.11	
	b. 2.28	1.01	
	c. 2.22	1.16	
Average	2.29	1.09	17.9

ACID SKIM MILK

Cultures	Percentage of casein	Percentage soluble nitrogen expressed as protein	Percentage of casein digested
Uninoculated control	*a.* 2.32	.74	
	b. 2.41	.58	
Average	2.36	.66	
P. roqueforti	*a.* .82	2.13	
	b. .70	2.25	
	c. .70	2.26	
Average	.74	2.21	68.6
Culture 16 (from Wensleydale cheese made Aug. 3, 1922)	*a.* 1.90	1.05	
	b. 1.93	1.07	
	c. 1.98	1.03	
Average	1.94	1.05	17.8

Both the skim milk and the acid skim milk tubes, at the end of the incubation period, were analyzed for the percentage of casein left in the milk, by precipitation with acetic acid as given in the A.O.A.C. (**8**) Kjeldahl, and determinations were made on both the precipitate and the filtrate. The percentage of nitrogen in the former is expressed as casein, and in the latter as soluble nitrogen expressed as protein—tables I and II. Though for comparison the nitrogen in the filtrate has been expressed as soluble protein, it is well to remember that this figure includes all the decomposition products of protein.

Referring to table I, it will be noticed at once that considerable digestion of the casein has taken place with the *P. roqueforti* cultures and only about one fourth as much when using the cultures of the Wensleydale mold. The results of the skim milk cannot be directly compared with the results of the acid skim milk, for the organisms are aërobic and the areas of surface of milk exposed were not identical.

Owing to the great difference in the rate of digestion by the two organisms, the determinations were repeated in Erlenmeyer flasks —table II. The use of the flasks provided for a greater surface area of milk and permitted more specific comparison of results. The results of this experiment—table II—are most striking and very uniform when it is considered that the proportion of inoculation is unavoidably variable. The conclusions to be drawn from tables I and II are:

1. Both *P. roqueforti* and the mold from the Wensleydale cheese digest casein in milk, but the rapidity of digestion of the former is four times that of the latter.

2. The rate of digestion of the casein is much greater where there is a large surface of milk exposed.

3. There is little difference in the rate at which the skim milk and acid skim milk respectively are digested when inoculated with either culture.

Growth on synthetic media.—The basic synthetic medium used was that recommended by A. W. Dox (**2**) (**6**), details of which medium are given in table III. Using this medium, the ten varieties of the same, as detailed in table III, were prepared. For each

medium, eight 50 c.c. Erlenmeyer flasks containing 20 c.c. of the required medium were prepared, plugged, and sterilized, and inoculated in duplicate with cultures 15, 16 and *P. roqueforti* respectively. Two flasks uninoculated as control were retained. After incubation at 21° C. for 10 days the degree of growth of the mycelium was determined by its weight. The cultures and media were filtered through a Gooch crucible, the mycelium was washed with distilled water, oven dried at 100° C. till constant, and weighed.

TABLE III

WEIGHT OF FELT PRODUCED BY CULTURES IN 20 C.C. OF SPECIFIC MEDIA SHOWN GROWN AT 21° C. FOR 10 DAYS IN ERLENMEYER FLASKS

Medium	Mold from Wensleydale cheese			
	Culture 15, grams	Culture 16, grams	*P. roqueforti*, grams	Uninoculated, grams
Synthetic medium[1]	.0011	.0013	.0010	.0009
" " + 2.5% saccharose	.0102	.0189	.0512	.0008
" " + 2.5% lactose	.0136	.0154	.0088	.0004
" " + 2.5% galactose	.0173	.0105	.0321	.0007
" " + 2.5% levulose	.0208	.0175	.0651	.0002
" " + 2.5% dextrose	.0754	.0435	.1008	.0003
" " + 3.0% peptone	.0375	.0438	.0268	.0021
" " + 2.5% lactose + lactic acid	.0129	.0066	.0143	.0003
" " + .7% lactic acid	.0038	.0036	.0050	.0001
" " + 3.0% casein	.0443	.0318	.0225	.0005

Referring to table III, the weights of mycelium representing the degree of growth show the following points of interest:

1. The weights of mycelium from the cultures of *P. roqueforti* are always greater than or less than are those from cultures 15 and 16.

[1] The synthetic medium was Czapek's formula modified by A. W. Dox, Chas. Thom (2 & 6).

2000 c.c. distilled water
1 gram magnesium sulphate
2 grams dipotassium phosphate
1 grain potassium chloride
.02 gram ferrous sulphate
4.0 grams sodium nitrate

The casein was obtained in colloidal suspension by the method adapted by S. Henry Ayers (9).

2. In the media containing four of the sugars saccharose, galactose, levulose, and dextrose respectively, *P. roqueforti* produces a much greater growth than do cultures 15 and 16: while the opposite result is obtained in a medium containing lactose.

3. In the medium containing peptone and casein respectively, each of the cultures 15 and 16 produce greater growth than is given by *P. roqueforti.*

4. *P. roqueforti* produces a greater growth where lactic acid is present either with or without lactose than is produced by either cultures 15 or 16.

TABLE IV

NUMBER OF C.C. OF *n*/10 $Ba(OH)_2$ NEUTRALIZED BY GAS GIVEN OFF FROM 10 C.C. OF SKIM MILK. CULTURES GROWN IN ELDREDGE TUBES AT ROOM TEMPERATURE

	Culture	Series *A*. Inoculated Aug. 6, 23			Series *B*. Inoculated Aug. 18			
		A Day's growth			*B* Day's growth			
		2	4	6	2	4	6	8
(From Wensleydale cheese made Aug. 3, 1922)	16	.4	4.5	6	3.4	7.1	8.2	9.3
(From Wensleydale cheese made May 29, 1922)	15	.8	4.7	5.6	3.0	6.9	6.7	9.3
P. roqueforti		.6	4.2	9.4	2.0	5.3	11.7	16.8
" "					2.5	6.8	16.0	13.0

Carbon dioxide production.—Eldredge tubes (**10**) were filled with 10 c.c. of skim milk plugged and sterilized. Eight cultures of the Wensleydale mold and of *P. roqueforti* respectively were then used for inoculation, employing four tubes for each culture. The other side of the tube was filled with 10 c.c. *n*/10 $Ba(OH)_2$ and the tubes corked with rubber stoppers. The CO_2 produced was measured by the reduction in alkalinity of the *n*/10 $Ba(OH)_2$ on the second, fourth, and sixth day—table IV–*A*. As all the *n*/10 $Ba(OH)_2$ was used up on the eighth day, a second series—table IV–*B*—was run using 15 c.c. of *n*/10 $Ba(OH)_2$.

From these determinations, the chief points of interest are:

1. A considerable quantity of CO_2 is produced by the various cultures of the Wensleydale mold and by *P. roqueforti.*

2. There is no marked difference in the results from any culture till the sixth day, after which the *P. roqueforti* has an increasingly greater CO_2 production in comparison with any of the Wensleydale mold cultures.

Temperature relations.—The object of these determinations was to find the approximate, optimum, maximum and minimum temperature at which the Wensleydale molds would grow, and to compare the same with the growth of *P. roqueforti.*

The molds were grown in Petri dishes on a potato agar medium containing 2 per cent dextrose. The plates were poured, allowed to solidify, and inoculated in duplicate with cultures of the Wensleydale mold and *P. roqueforti* respectively, using a platinum wire. Five incubators were used varying in temperature from 4.5° C. to 36.6° C. and duplicate plates of each culture were placed in each incubator—table V.

To express the degree of growth from day to day the decimal method as described by Thom (**6**) was adopted—table V, footnote. This method proved satisfactory in showing the rate at which the colonies matured. The amount of growth produced, however, would have been more satisfactorily determined by applying the method of weighing the mycelium—defined on page .

Before referring to the results, it should be noted that the slight growth on the first day on the plates incubated at 36.6° C. was caused by this incubator being at 32° C. for the first day, but subsequent to this, the temperature remained just under blood heat. The other incubators varied but slightly, and their limits of variation are given in the second footnote of table V.

Referring to the results in table V, the following conclusions may be drawn:

1. All the cultures at the same temperature, including both the Wensleydale molds and the *P. roqueforti,* grow at about an equal rate.

2. None of the cultures grow at blood heat.

TABLE V

INCUBATION EXPERIMENTS

CULTURES GROWN IN PETRI DISHES ON POTATO AGAR + 2% DEXTROSE
METHOD OF EXPRESSING GROWTH AS GIVEN BY THOM (6)

Culture	Incubator temperature average	Growth period in days													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
16 (from Wensleydale cheese made Aug. 3, 1922) . . .	4.5				.15		.3		.4		.7		.8		.9
	14.1		.1		.65		.9		1						
	20.6	.35	.7	.9	1										
	28.9	.4	.7	.9	1										
	36.6	.15													
15 (from Wensleydale cheese made May 29, 1922) . .	4.5				.1		.3		.4		.7		.8		.9
	14.1		.2		.7		.95		1						
	20.6	.35	.7	.9	1										
	28.9	.4	.7	.9	1										
	36.6	.2													
P. roqueforti	4.5				.1		.2		.35		.7		.8		.9
	14.1		.2		.65		.9		1						
	20.6	.3	.7	.9	1										
	28.9	.3	.7	.9	1										
	36.6	.3													

EXPLANATION OF DECIMALS: 0.1 denotes germination of conidia only; decimals up to 0.7, growth without the formation of colored conidial areas; 0.7 to 1.0 denotes typical colony.

LIMIT OF VARIATION OF THE FIVE INCUBATORS

Average	Maximum	Minimum
4.54	6.0	1.5
14.1	14.5	14.
20.6	21.5	18.5
28.9	31.	27.5
36.6	37.5	32.

3. The optimum, maximum, and minimum temperatures, while they cannot be clearly fixed, are shown to be about as follows:

Optimum between 20.6° C. and 28.9° C.

Maximum above 28.9° C. and below 36.6° C.

Minimum below 4.5° C.

It is not possible at this stage to conclude whether or not the differences as shown in this work justify an assumption that the Wensleydale mold and *P. roqueforti* may be considered as different varieties of the same species, or different species. Work on this phase of the investigation is still in progress.

SUMMARY

The dominant mold obtained from the Wensleydale cheese is not identical with *P. roqueforti*. There is at least one marked difference in the structure of the colonies on potato agar. The *P. roqueforti* produces large white areas of closely interwoven mycelium. These have never been noticed in the case of the Wensleydale strain.

The reactions on some of the constituents of the media used are different. This difference is usually more a question of degree of growth or rate of change than a direct positive or negative result. These differences may be briefly summed up as follows:

1. The Wensleydale strain produces a slight degree of acidity in whey-peptone-litmus-gelatin, while *P. roqueforti* does not.

2. The digestion of the casein of milk which has been inoculated with *P. roqueforti* is four times as rapid as is the case when milk is inoculated with the Wensleydale mold.

3. The Wensleydale strain grows less freely than does *P. roqueforti* on synthetic medium containing saccharose, galactose, levulose, and dextrose, respectively.

4. The Wensleydale strain grows more freely on synthetic media containing casein and peptone respectively than does *P. roqueforti.*

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UNIVERSITY OF BRITISH COLUMBIA

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CORYNEUM RUBORUM OUD. AND ITS ASCOGENOUS STAGE

S. M. Zeller

(With Plate 3)

Introduction

A *Coryneum*, which answers in every morphological character the description of *Coryneum Ruborum* Oud., is widespread in Western Oregon. As suggested by the specific name the genus *Rubus* is host for this organism. It has been observed on several varieties of red and black raspberry (*Rubus strigosus* Mich. and *R. occidentalis* Linn., respectively). The pathogenicity of the organism has not been determined, so that the writer has no information on the exact amount of damage done, although the infections have a general range in the raspberry plantings of all the fruit growing districts in the western part of the state.

General Description of Lesions

The lesions are found on the fruiting canes, the first appearance being noticed in the late fall and winter months when the epidermis of the affected portions becomes brownish on red raspberry and bluish on black raspberry canes. Later these same areas become ashen on red varieties and bluish with a silvery bloom on black varieties of raspberry. The affected areas are usually from 7–20 cm. long and as a rule do not extend completely around the stems. In the earlier stages of infection the discoloration of the host tissues extends to a depth of but a few cells below the epidermis. There seems to be no evidence, without artificial inoculations, that the fungous invasion extends much deeper before harvest of the berry crop the following summer. Inoculations will be carried out during the present season to determine the symptoms during the progress of lesion formation and the damage done to affected canes. In the early spring, February and March, the affected areas become dotted with reddish brown spots, ranging in size

from 120 μ to 350 μ, which are the acervuli. After the dark-fuliginous conidiospores have been discharged the bark immediately surrounding the pustules takes on a sooty appearance. At this time of year the epidermis of the lesions usually remains intact but in some cases the epidermis cracks in longitudinal and circumscribing lines and peels back giving a shaggy appearance to the cane (See Fig. 1).

FIG. 1. Canes infected with *Corneum Ruborum*

The lesions usually center around nodes or run downward from a node. For this reason there is some indication that infection may take place through leaf scars, cracks in the axles of buds or

branches, and in the case of black raspberry, cane infection has been noted at pruning cuts. In a few cases internode lesions without evident wounds have been observed.

The acervuli begin to appear in late August and early September. In the fall of 1923 the first appearance in the Ashland District of the Rogue River Valley was toward the middle of September while in the Willamette Valley the acervuli were seen during the first week in August. From this time in early fall until June of the following spring acervuli are found liberating conidia. This period of conidiospore liberation corresponds with the period of infection by *Coryneum Beijerinckii* Oud. for the same districts.

The ultimate longevity of the spores of *Coryneum Ruborum* is not known but we do know that they will withstand desiccation of room temperatures for two years. Conidiospores from red raspberry canes collected by H. P. Barss, April, 1922, were plated out in potato glucose agar Mar. 31, 1924, and on Apr. 10 there was evidence of nearly 100 per cent germination. Smith [1] says that the conidia of *Coryneum Beijerinckii* appear to live through the summer in California lodged in the bud scales of peach and are thus very resistant to desiccation.

ASCOGENOUS STAGE DESCRIBED

On March 12 of last year the ascogenous stage of *Coryneum Ruborum* was discovered by the writer on two-year-old canes of Cuthbert red raspberry which were lying on the soil in an unattended planting. More material was secured on April 21. On these weathered and partially decayed canes the epidermis was loose but dotted by the erumpent acervuli of the *Coryneum* stage as well as perithecia of an ascomycete. Upon diagnosis the latter proved to belong to the genus *Ascospora*. Since Vuillemin [2] had referred to the connection of *Coryneum Beijerinckii* Oud. with an *Ascospora*, the present discovery of acervuli of *Coryneum Ruborum* Oud. in close proximity to perithecia of *Ascospora* on *Rubus* became of immediate interest.

[1] Smith, R. E. California peach blight. Calif. Agr. Exp. Sta. Bull. 191: 73–98. 1907.

[2] Vuillemin, P. L'Ascospora Beijerinckii et la maladie des Cerisiers. Jour. de Bot. 2: 255–259. *f. 1–2.* 1888.

In March many immature perithecia of this *Ascospora* were observed, but the majority were mature and discharging ascospores. It is evident, then, that ascospores begin to be liberated in early March and an observation on April 21 showed no immature perithecia present on the lesions collected at that time.

The perithecia are variable in size from 100 μ to 200 μ. They are carbonaceous and depressed globose, and the walls are from one to three cells thick. The ostiole is very small, circular to lenticular, not papillate. The perithecia are usually erumpent, seated upon a subepidermal layer of ramifying, brown mycelium, which is thickened into a pseudoparenchyma directly beneath the perithecia. The branches of the mycelium usually extend in the direction of the long axes of the cells of the host tissue. This character is illustrated in figures 4 and 5 in plate 3. Figure 4 shows a perithecium and ramifying mycelium on the host tissues after the epidermis has been lifted away.

The asci come from the crushed perithecia in fascicles, attached at the base. They measure 40–55 μ by 9–12 μ, are cylindrical to curved and contain 8 spores surrounded by epiplasm which is more or less distinctly attenuated above and below the line of spores, which are one to two seriate.

Paraphyses are not found among the asci.

Ascospores are hyaline, unicellular, ellipsoid, obtuse at both ends, 10–13 x 4–5 μ.

SPORE DISCHARGE

In water the epiplasm of an ascus evidently has great powers of imbibition under which condition the ascus greatly elongates. In this process of elongation the wall of the ascus remains rigid in its original form, merely the apical portion assuming a gelatinized condition and expanding to allow the inner sheath (or plasma membrane?) to elongate under pressure into a tube, usually exceeding the length of the ascus below. The upper end of the ascus-wall is defined by a very fine line. The spores are slowly carried by the epiplasm into the elongated tube. Finally the tension of the apical membrane, which doubtless becomes thinner and less dense, suddenly breaks and the spores are forcibly ejected for some distance.

In the case of *Ascospora Beijerinckii* (Oud.) Vuil. the ascospores were observed by Vuillemin to be projected to a distance of two millimeters under water, "in spite of the resistance of the water and the friction of the glass." This type of spore ejection has been observed by other members of the staff at this laboratory in other species of ascomycetes. Among these were *Mycosphaerella rubina* (Peck.) Jacz., *Venturia inaequalis* (Cooke) Aderhs., *Plowrightia ribesia* (Pers.) Sacc., and perhaps, many others disperse spores in a like manner but the details of the process are seldom referred to in literature.

To determine whether this is the manner in which ascospores are ejected from the perithecia of this species the following observation was made. A piece of subepidermal tissue with perithecia was placed in water for about 15 minutes and then placed under the microscope for observation. After about 20 minutes in water tiny pearly white bodies were seen to appear in the ostioles. Some times three crowded out together. Under the high (dry) power of the microscope a few of these could be identified as asci protruding from the ostioles. This illustrates the necessity of accumulated moisture to bring about spore discharge in this species, *i.e.*, such moisture as might accumulate on berry canes after rain or condensation from high atmospheric humidity. It is probable then that ascospore discharge in Oregon is limited to the period from about the first of March until the end of the rainy season or such time when foggy nights are not frequent.

CONNECTION BETWEEN ASCOGENOUS AND CONIDIAL STAGES ESTABLISHED

Cultures of two types have been secured of the organism in question, *i.e.*, those from the conidiospores and those from ascospores.

In the first case spores from the *Coryneum* acervuli were diluted in the usual way and poured Petri-dish plates of potato glucose agar were prepared. Colonies from individual spores were transferred from such plates to agar slants.

In the case where cultures were prepared from ascospores the method of ejection of spores from the ascus, described above, was

taken into consideration. Since *Coryneum* spores were present in nearly all water mounts they were first washed away. In order to do this a cluster of asci were held with a sterile needle against a microscope slide while the slide was repeatedly rinsed with sterile water from a wash bottle. After this process a microscopic examination showed no *Coryneum* spores present. Now by pressure on the cover glass the asci were forced apart until an individual ascus could be picked up in a fine capillary glass tube. After this was accomplished the tube was deposited horizontally in a damp chamber until the ascus had discharged its spores. Five different asci were so treated and the remaining asci which still clung together were drawn into a capillary tube and treated likewise. None of the asci discharged all of their spores, as observed under the microscope, from one to four remaining in an ascus. Then, the contents of the six capillary tubes were blown into test tubes of potato glucose agar and after agitation Petri-dish plates were poured in the usual way. The plates were poured on March 14 and colonies of fungi and bacteria which appeared on the plates were each transferred to agar slants in test tubes on March 18 and 20. Sixty-two such transfers were made, out of which 36 colonies had yielded pure cultures of *Coryneum Ruborum* Oud., while the remainder were contaminations of bacteria and *Penicillium*.

The results of the poured plates are given in the accompanying table.

TABLE I

RESULTING COLONIES OF *Coryneum* FROM GERMINATION OF ASCOSPORES OF *Ascospora*

Capillary tube	Number of spores discharged from ascus	Colonies of *Coryneum Ruborum* resulting from ascospores	Remarks
a	5	5 out of possible 6	3 bacterial colonies
b	none	1 " " " 1	3 *Penicillium* colonies 8 bacterial colonies
c	6	6 " " " 7	
d	4	5 " " " 5	11 bacterial colonies
e	7	7 " " " 8	
f	many	12	1 *Penicillium* colony

It will be noticed that a few of the ascospores were lost, probably in the agar adhering to the test tubes after pouring the plates.

The writer is certain that no *Coryneum* spores were in the capillary tubes and that the *Coryneum* colonies resulted from the germination of the ascospores of the *Ascospora*. The *Coryneum* cultures obtained in this manner are in every particular similar to those obtained from *Coryneum* acervuli on the host plants. In Plate 3 the conidiospores from the host are illustrated in figure 2, while figure 3 illustrates conidia produced in culture from ascospores of *Ascospora*.

When cultures of the organism are transferred to a medium of sweet clover stems (*Melilotus alba*), the more or less typical acervuli are formed, although superficial rather than erumpent.

AFFINITIES OF *Ascospora* STAGE

The *Ascospora* in question differs from other described species of the genus. Its nearest affinities in a morphological sense are with *Ascospora Beijerinckii* (Oud.) Vuillemin, although there are several distinct points of difference. The asci average smaller as do also the ascospores.

If Vuillemin's hypothesis, that *Coryneum Beijerinckii* Oud. is the imperfect stage of *Ascospora Beijerinckii*, is to be accepted without cultural evidence, the affinity of this species with the one found on *Rubus* is a close one. However, the conidia of the two species are distinct in size, color and septation, the latter having conidia darker in color, averaging 14 x 6.5 μ, and invariably 3-septate, while those of the former are lighter in color, 30–45 x 14–17 μ, and 1–5-septate. The two species are also distinct in host relationship.

Since the organism described in detail above has been proven to be the ascogenous stage of *Coryneum Ruborum* Oud., the new combination **Ascospora Ruborum** (Oud.) becomes necessary and the following condensed description is perhaps desirable in this connection.

CONDENSED DESCRIPTION

Ascospora Ruborum (Oud.) Zeller n. comb.

Perithecia at first subcuticular, becoming erumpent, 100–200 μ, carbonaceous arising from a ramifying *cushion* of dark mycelium

which is pseudoparenchymatous directly beneath; *walls* thin; *ostiole* small, circular to lenticular, not papillate; *asci* cylindric, inequilateral, mostly larger below, hyaline, 8-spored with a distinct epiplasm, 40–55 x 9–12 μ, elongating before spore discharge; *paraphyses* none; ascospores ellipsoid, obtuse at both ends, hyaline seldom guttulate, 10–13 x 4–5 μ.

Conidial stage, *Coryneum*. *Acervuli* erumpent, breaking irregularly, 120–350 μ; *conidiophores* from a subepidermal pseudoparenchyma, slender, hyaline, 18–32 μ long; *spores* ellipsoid, more obtuse at the apical end, dark fuliginous, 3-septate, 11–18 x 6–7 μ.

On fruiting canes of *Rubus*.

Specimen examined—*Ascospora* stage.

Corvallis, *S. M. Zeller*, type (in Zeller Herb. *2638, 2654,* in O. A. C. Herb. *3751*).

Coryneum stage.

Corvallis, *S. M. Zeller* (in Zeller Herb. *2481, 2488, 2638, 2640, 2654*); Ashland, *S. M. Zeller* (in Zeller Herb. *2547*), *F. C. Reimer* (in Zeller Herb. *2632*); Springbrook, *S. M. Zeller* (in Zeller Herb. *2646*); *H. P. Barss* (in O. A. C. Herb. *3752*).

SUMMARY

A description of the characteristics of lesions on canes of red and black raspberries caused by *Coryneum Ruborum* Oud. is given. The technique involved in obtaining pure cultures of this organism from the ascospores of the perfect stage, *Ascospora Ruborum* (Oud.) Zeller, is also described.

OREGON AGRICULTURAL EXPERIMENT STATION,
CORVALLIS, OREGON

DESCRIPTION OF PLATE 3

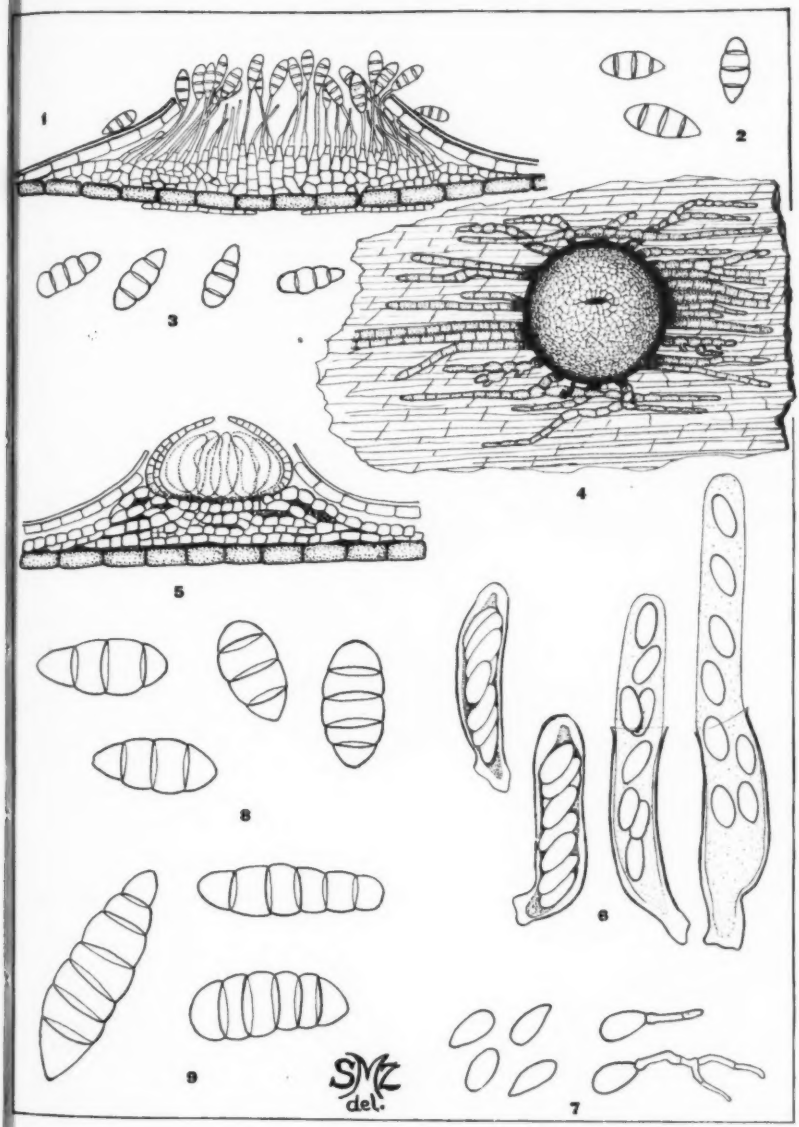
Camera lucida drawings

Fig. 1. Vertical longitudinal section of an acervulus of the *Coryneum* stage of *Ascospora Ruborum*. × 200.

Fig. 2. Conidiospores of the same fungus from the host, *Rubus strigosus*. × 666.

Fig. 3. Conidiospores from a culture obtained from the germination of an ascospore of *Ascospora Ruborum*. × 666.

Fig. 4. Perithecium of *Ascospora Ruborum* showing the ramifications of the subepidermal mycelium after the epidermis has been lifted away. × 200.



CORYNEUM AND ASCOSPORA

Fig. 5. Vertical section of an erumpent perithecium showing a section of the subepidermal mycelium with its pseudoparenchymatous character beneath the perithecium. × 200.

Fig. 6. Asci of *Ascospora Ruborum*, two of which show the elongation of the inner membrane when the epiplasm imbibes water. Through such elongation the ascus extends through the ostiole before the spores are discharged. × 666.

Fig. 7. Ascospores, two of which have germinated. × 666.

Fig. 8. Conidiospores of the *Coryneum* stage of *Ascospora Beijerinckii* (Oud.) Vuil. From an acervulus on peach bark. × 666.

Fig. 9. Conidiospores of the same fungus from culture. × 666.

NOTES AND BRIEF ARTICLES

The first four parts of " Icones Fungorum Malayeansium " have recently appeared. It is the intention to issue twelve parts per year, each part to consist of one finely colored plate with a number of figures of the fungi of the Dutch East Indian Archipelago, accompanied by descriptive text in German. The first four parts are devoted to the Clavariaceae.

Under the title " Notes on parasitic fungi in Wisconsin IX–X–XI," in the Transactions of the Wisconsin Academy of Sciences **21:** 251–302, Dr. J. J. Davis described the following new species: *Ramularia tenuis* on the leaves of *Solidago latifolia; Synchytrium cinnamomeum* on *Ranunculus recurvatus* and *Ranunculus septentrionalis; Synchytrium nigrescens* on *Aster lateriflorus; Macrophoma arens* on *Koeleria cristata; Asteromella astericola* on *Aster lateriflorus; Stagonospora albescens* on *Carex tribuloides; Septogloeum querceum* on *Quercus bicolor; Cercospora Molluginis* on *Mollugo verticillata; Tuberculina argillacea* on *Rubus allegheniensis* and *Rubus occidentalis; Phyllosticta Ambrosiae* on *Ambrosia trifida; Septoria cenchrina* on *Cenchrus carolinianus; Colletotrichum Violarum* on *Viola scabriuscula; Septogloeum subnudum* on *Smilax herbacea; Cladosporium caducum* on *Betula nigra; Cercospora crassoides* on *Froelichia floridana; Puccinia Caricis-shepherdiae* on *Carex eburnea.*

The Snapdragon Rust

Attention has recently been called to the destructive work of the snapdragon rust known scientifically as *Puccinia Antirrhini* Diet. & Holw. A New York correspondent, Mr. H. A. Gibbs, writes as follows: " The disease appeared first five years ago on plants outside in the garden. The following year seedlings were grown

in the greenhouse and were immune. Next year I did not grow any of this kind of plant at all, but in 1922 we lost fully 1,000 plants which had arrived at about the height of this sent herewith. In 1923 we got about 85 per cent of the plants free from disease, but these were removed from the greenhouse and put into cold frames and after that very little rust appeared."

This fungus was originally described from material collected in California, the description being published by a German in a European botanical journal, in 1895. The California specimens were collected by W. C. Blasdale, who in a note published in 1903 states that the fungus has appeared there every year since and in every case destroyed the plants shortly before they had reached the flowering stage.

In 1913 the fungus was reported as responsible for a great deal of damage to the cultivated snapdragon in the vicinity of Chicago. The disease continued to spread rapidly until it is now found wherever the host is grown in the greenhouse.

Beautifully rusted specimens have been received from the correspondent quoted above and since the matter may be of interest to others it is thought well to publish this brief note. While the fungus is well known and widely distributed in this country the control methods have not been very satisfactorily worked out. We will publish a summary of the work done along this line in Illinois.

Control

The control methods recommended by Mr. George L. Piltier of the Illinois Experiment Station, where a great deal of damage has been done and many experiments conducted, are as follows:

"Snapdragon rust may be partially controlled in the greenhouse by giving attention to cultural methods. Growing the plants under the best conditions in a clean, well-kept, and well-ventilated house will check to some extent the dissemination of the disease. Plants should not be syringed if this can possibly be avoided but instead the soil only should receive water when the plants require it.

"In order to eliminate the rust, it is recommended that all infected material be destroyed, the house cleaned, and after a year or

two new stock secured which is free from rust. The latter may be secured by the use of seed and the practice of selection."

FRED J. SEAVER

BOTANIZING IN VIRGINIA

On October 18 I drove with a party of friends to Danville, 73 miles south of Lynchburg, stopping at several points on the way. Chatham was the most interesting town seen en route, reminding me of Bedford but lacking its elevation and its splendid view of the Peaks of Otter. The vegetation gradually acquired elements of the coastal flora as we approached Danville; well-built barns for bright-leaf tobacco became abundant; and finally the road was bordered with fields of cotton.

What could be more beautiful than a Virginia autumn, when the days are warm, the nights studded with stars, and the woods crimsoned with black gum, sourwood, and sumac! In Sweden and our Northwest, the aspen poplar brightens the gloom of the coniferous forest at this season, but in Virginia the flame of the giant poplar rises gloriously above all competitors and may be seen for miles.

Fungi were few because of the dry weather, but those found were characteristic. The deadly *Amanita* in its white form, the fly *Amanita,* the honey agaric so destructive to oaks, several kinds of *Russula,* the edible fall *Boletus* (*Rostkovites granulatus*), four species of puffballs, most of them ripe and ready to distribute their millions of dust-like spores, and many smaller fungi found on dead wood, indicated to me that little if any change takes place in the fungous flora between Lynchburg and Danville.

W. A. MURRILL